

Shockwave Fabrication of High Performance Thermoelectrics, Phase II

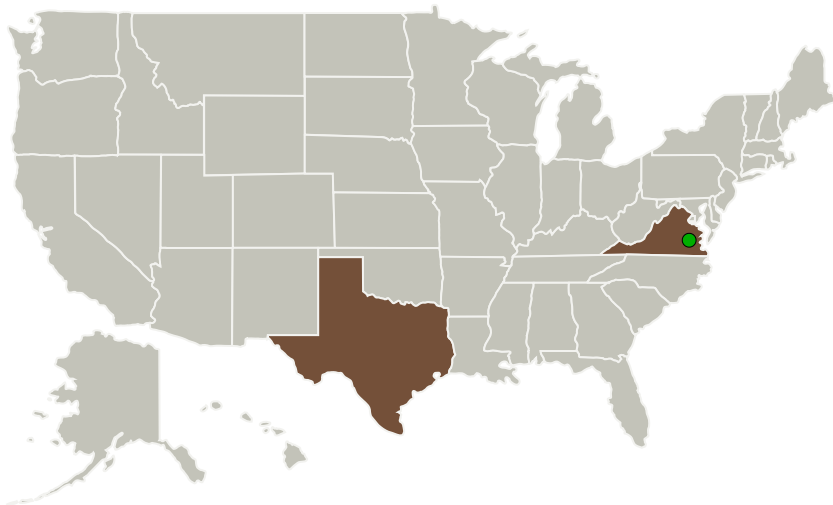
Completed Technology Project (2010 - 2012)



Project Introduction

Thermoelectric (TE) generators have the advantages of no moving parts and flexibility in deployment but suffer from low heat to electricity conversion efficiencies, with a major loss component being conductive (phonon) heat transfer through the TE lattice. By using a high pressure shockwave consolidation, nanopowders can be fused into a solid bulk TE material while preserving the nanostructure. The high density of grain boundaries and lattice defects impedes phonon transport while allowing electron flow. Specific Phase 2 research thrusts will be directed at transitioning laboratory fabrication into volume manufacturing, at producing a graded thermoelectric that is optimized for different temperature ranges over the length of the element, and at preparing bulk thermoelectric material from transition metal trichalcogenides that are not appropriate for melt or powder sintered fabrication. The overall conversion efficiency of a TE device will always be limited by the Carnot ratio of $(T_h - T_c)/T_h$, where T_h and T_c are the temperatures of the hot and cold junctions. With the restrictions on phonon transport accruing from nanopowder consolidation, conversion efficiencies in excess of 30% of the Carnot limit are reasonable.

Primary U.S. Work Locations and Key Partners



Shockwave Fabrication of High Performance Thermoelectrics, Phase II

Table of Contents

Project Introduction	1
Primary U.S. Work Locations and Key Partners	1
Project Transitions	2
Organizational Responsibility	2
Project Management	2
Technology Maturity (TRL)	2
Technology Areas	3
Target Destinations	3

Shockwave Fabrication of High Performance Thermoelectrics, Phase II

Completed Technology Project (2010 - 2012)



Organizations Performing Work	Role	Type	Location
TXL Group, Inc.	Lead Organization	Industry	El Paso, Texas
● Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia
The University of Texas at El Paso	Supporting Organization	Academia	El Paso, Texas

Primary U.S. Work Locations

Texas	Virginia
-------	----------

Project Transitions

**August 2010:** Project Start**November 2012:** Closed out

Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/140688>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

TXL Group, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

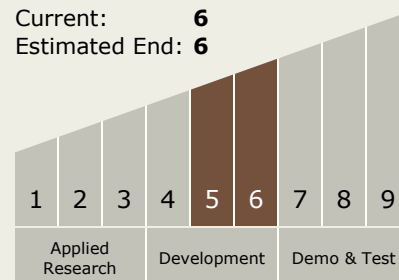
Carlos Torrez

Principal Investigator:

David C Nemir

Technology Maturity (TRL)

Start: 5
 Current: 6
 Estimated End: 6



Shockwave Fabrication of High Performance Thermoelectrics, Phase II

Completed Technology Project (2010 - 2012)



Technology Areas

Primary:

- TX03 Aerospace Power and Energy Storage
 - └ TX03.1 Power Generation and Energy Conversion
 - └ TX03.1.3 Static Energy Conversion

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System